Missouri Department of NATURAL RESOURCES
dnr.mo.gov
Michael L. Parson, Governor
Carol S. Comer, Director

May 13, 2020

Christine Jump, Project Manager
Superfund Division
United States Environmental Protection Agency, Region 7
11201 Renner Boulevard
Lenexa, Kansas 66219

RE: Review of Draft OU-1 Design Investigation Work Plan and Associated Documents, West Lake Landfill Operable Unit 1, Bridgeton Missouri, Dated March 2020

Dear Christine Jump:

The Missouri Department of Natural Resources' (Department) Federal Facilities Section has reviewed the above referenced documents.

Upon review of the above referenced documents, we continue to be disappointed by the lack of information provided in the submittals of these critical early design documents. The early documents in this remedial design phase are intended to ensure the responsible parties are pursuing a path that is consistent with the ROD amendment remedy while minimizing the chance for disruptions late in the design that may cause substantial schedule changes. We continue to be frustrated by the lack of transparency or relevant details necessary to provide regulatory oversight.

Statements in the draft report indicate that the purpose of the geostatistical model will be for the specific purposes of: 1) approximating total activity and 2) estimating the probability of the presence of RIM that is greater than 52.9 pCi/g. Based on the limited scope of the model as described, investigation that is necessary to answer other questions and data gaps should be clearly detailed in the DIWP and incorporate measurable decision criteria that is independent of the modeling output.

Thank you for giving us the opportunity to review and provide feedback on this material. If you have any questions or need further clarification, please contact me by phone at (573) 751-8628, or by written correspondence at P.O. Box 176, Jefferson City, MO 65102.

Sincerely,

ENVIRONMENTAL REMEDIATION PROGRAM

Ryan Seabaugh, P.E.
Federal Facilities Section

RS:rl

c: Mr. Tom Mahler, Remedial Project Manager, EPA Region 7 (Email)
Mr. Chris Nagel, Director, Waste Management Program (Email)

Draft Design Investigation Work Plan and associated documents
West Lake Landfill Superfund Site Operable Unit 1
Dated March 2020

General Comments

1. Throughout the design development process, we have been unable to receive a clear understanding of the responsible parties' geostatistical model development or the magnitude and impact of "pragmatic adjustments" made to model parameters. As of the time of submittal of this draft design investigation work plan, information that is still lacking or insufficient includes:
   - Proposed borings located on the permit map.
   - Electronic spreadsheet of the proposed boring locations and elevations/depths.
   - Formal evaluation of using soft data to predict thorium concentrations including the estimation of a reasonable detection limit for Ra-226 and the approximate Th-230 concentration that corresponds to this detection limit.
   - Evaluation and further supporting information related to the development of the CDFs including further justification of manual adjustments of the CDF.
   - Sensitivity analyses for both geostatistical models depicting changes in extent and relative activities.

   Requests for better understanding of the geostatistical model is not new. Starting on March 13, 2017, when DNR first encountered soft data correlation into the geostatistical model, the same or substantially similar questions continue to be asked in order to shed some light into the inner workings of the geostatistical modeling process. At the same time, the role of the model has changed from estimating RIM extent in the RI/FS for the purpose of selecting a remedy to primarily providing a definitive activity calculation for deciding if the excavation meets the requirement of the ROD selected remedy.

   In order to alleviate continuing questions on the geostatistical model prior to its introduction in the revised excavation plan and pre-final design, the responsible parties have continually described the current geostatistical model during discussions as "just one tool" to provide decision-makers some insight into where sampling and borings may need to be conducted. We agree that based on the lack of detail of the internal workings of the model as presented, the model should be limited to a minor supporting role in estimating boring locations and sample intervals. The model may be utilized in a line-of-evidence based approach in conjunction with what has been described by the responsible parties as a "grey matter" exercise in determining boring numbers, locations, and depths.

Informing the "grey matter" include lines of evidence such as the conceptual site model and physical samples/data that were not incorporated into the geostatistical modeling program.

Conceptual Site Model (CSM):

Attempts to reference the CSM as presented by the responsible parties were marginally successful. In order to be appropriate for remedial design, as stated in our comment letter dated April 10, 2018 on the proposed plan, data gaps in the characterization of RIM needed to be addressed by the amended record of decision and subsequent remedial design to account for historical information and aerial photo analysis of relevant time periods. Our previous comment is further supported by EPA fact sheet 542-F-11-011 which describes the CSM as "an iterative, 'living representation' of a site[18]", that evolves through the entire CERCLA process in order to function as a primary project planning and management tool. Since the responsible parties have minimally applied these concepts to attempt to identify all potential boundaries between OU-1 and OU-2, we have further developed the conceptual site model to include underutilized documents consistent with our previous concerns. As such, it is expected that the information provided by contemporaneous documents as described herein will be applied to the CSM for use in the design investigation and subsequent remedial design. The CSM described by the responsible parties' primary documents may only be partially utilized, with preference given to available documents that are more contemporaneous or speak specifically to events occurring during and shortly after the time period of RIM transport to the site. Historical aerial photographs and other readily available documents and references will also be utilized to identify sampling needs.

General CSM from 1973 to 1975

In understanding the potential placement of RIM, it helps to start with some context on what was going on at the time that the RIM arrived at West Lake Landfill. In 1973, state regulation of solid waste landfills was beginning implementation. Landfills that continued to operate when state regulations took effect December 21, 1973 would be required to obtain a permit for their active landfilling units, and be under stricter standards for closure and post closure care. Based on documents for this time period, records indicate that the landfill operator was taking inventory of their active units and making a determination on which units would continue operating (become permitted), and which would be closed[1]. According to a 2008 Bridgeton Landfill Permit engineering report:

"Prior to coming under state regulatory authority in the early 1970s, West Lake Landfill, Inc. had six separate disposal areas on the site… Subsequent to MDNR formation, MDNR issued two permits for Areas 1-6. These were permit #218903 and permit #118903. It is not known exactly when each area was filled or

with what each area is filled. However, based on the engineering report prepared by Rogers and Associates, Inc. in March 1974 and the accompanying plan sheets prepared by the Elbring Company, the following comments can be offered:

- *Areas 1, 2, 3, 4, and 5 have all been used for both sanitary and demolition fill*
- *Areas 2 and 4 were to be closed and completed at the time of the writing of the above mentioned report* (March 1974)
- *Areas 1, 3, 5, and 6 were originally used as sanitary fill areas; however, following the above-mentioned report they were to be sealed off with 24 inches of clay and used for demolition fill only. These areas were subsequently permitted under permit #218903*
- *Area 6 is a partial and integral portion of Area 5 which had been completed as a fill area at the time of the writing of the above mentioned report* (March 1974)*"*

The boundaries of the referenced permit areas #1-6 are available in a 2011 waste limits investigation figure (Drawing 2), and will be further described as needed to support the CSM.

According to the authorization issued by the newly formed state department of natural resources on October 10, 1974, the disposal units referenced as areas #1, 3, 5, and 6 were approved for additional demolition waste disposal[10] pending issuance of a permit which occurred in January 1976[8].

Additionally, a permit was issued on August 27, 1974 for additional sanitary waste disposal. The areal extent of this permit (#118903) and addendum includes nearly all of the central and southern portion of the OU-2 Inactive Sanitary Landfill. Prior to waste disposal, a 2-foot layer of compacted clay with permeability less than 10^{-7} cm/sec was required over the existing pre-regulation waste.[9]

From a broad perspective, between 1973 and 1975, the landfill operator needed a substantial amount of fill material to place final cover on waste disposal units referred to as disposal areas #2 and #4, and to place final cover on pre-regulatory portions of other waste disposal areas prior to implementing their new permits. Based on common landfilling practices, fill was likely also needed to establish appropriate grading for stormwater management and for internal infrastructure. While it is not known how much total fill was needed to implement these actions, records indicate that approximately 43,000 tons of soil material containing approximately 8700 tons of leached barium sulfate was sent to West Lake Landfill from Hazelwood Interim Storage Site (HISS) from July 16 to October 9, 1973.[4] It was also noted that scans identified several remaining isolated areas of activity after removal of the top 12 to 18 inches of topsoil from HISS.[4]

Documentation isn't clear where the fill was staged (dumped) for use, but there are statements available from an NRC interview that provide some insight into the initial placement of RIM material.

"Fehr (superintendent of Plant No. 1 West Lake Landfill) *indicated that he recalled that about three years ago, B&K Construction Company had dumped what he understood to be clean fill in an area adjacent to the office building."*[4]

"Fehr advised that in 1974 the Missouri Department of Natural Resources advised West Lake to discontinue dumping in two areas on the site, one of those being the area where the B&K material was loaded. He indicated that this area was full anyway."[4]

Other fill material was likely received by the landfill during this time.

"It is concluded that the material in question is now buried under about three feet of clean soil at the West Lake Landfill." [4]

Known aerial photographs for this time period were taken on May 4 and August 19 in 1973 and on May 6 in 1974.

General CSM from 1976 to 1981

In response to allegations made in the St. Louis Post Dispatch in 1976 and follow-up request by the state's natural resources department, the Nuclear Regulatory Commission (NRC) began investigating the media allegations.[4] The NRC published their initial findings on January 4, 1977 and launched a number of radiological investigations throughout the late '70s and '80s. A 1982 report by the NRC described a fly-over radiological survey performed in 1978 that revealed two areas at West Lake Landfill with elevated surface radiation levels. The referenced figure 2 shows elevated readings in the northern portion of OU-1 Area 2 along the buffer zone boundary, and elevated readings in Area 1 with the strongest surface readings located approximately above the waste limit boundary of Permit #218903 referenced as permitted demolition area #2.[8] In November 1980, Radiation Management Corporation (RMC) under contract with NRC followed up with a preliminary site survey. That survey showed similar results for OU-1 Area 2, but surface scans in OU-1 Area 1 now only shows elevated readings in a small portion of the northern portion of OU-1 Area 1 near the access road.[5] Subsequent surface scanning in May 1981 indicated additional variation in results in OU-1 Area 1 suggesting that additional activities by the landfill operator was affecting radiological activity distribution at the surface.

"Two areas of elevated external radiation levels have been identified by this survey. Figure 3 shows the two areas as they existed in November, 1980, at the time of the preliminary RMC site survey. As can be seen, both areas contained locations where levels exceeded 100 uR/hr at 1 meter, and in Area 2, gamma levels as high as 3-4 mR/hr were detected. The total areas exceeding 20 uR/hr were about 3 acres in Area 1 and 9 acres in Area 2.

External gamma levels measured in May and July of 1981 are shown in Figure 4. These levels had decreased significantly, especially in Area 1, due to continuing activities at the landfill. In both cases, contaminated areas were covered with additional fill material. RMC estimates that about 4 feet of

sanitary fill was added to the entire area denoted as Area 1, and that an equal amount of construction fill was added to most of Area 2. As a result, only a small region of a few hundred square meters in Area 1 exceeds 20 uR/hr. In Area 2, the total area exceeding 20 uR/hr decreased by about 10%, and the highest levels are now about 1600 uR/hr, near the Shuman building.

Little surface contamination was found in Area 1, as would be expected due to fresh land fill cover over nearly the entire area. Several isolated spots of surface contamination in Area 2 were indicated by beta-gamma measurements, and later confirmed by surface soil sampling. These spots are generally located near the northwest edge of Area 2, which includes the berm that bounds the landfill at that point. Some erosion and run-off is evident along the top of the fill, apparently uncovering deposits of radioactive material in the process. Thus far, fresh construction fill has not been added here, due to the inaccessibility of these spots. A second region of surface contamination is found just north of the Shuman building. It is not clear why material appears on the surface here, except that it is possible that some digging or excavation has occurred here in the past."

Sometime during this period, there is an indication that a structure was constructed within OU-1 Area 2 based on diagrams and a description of "the Shuman Building" in the 1982 NRC report, in addition to an internal department memorandum dated November 19, 1980 discussing findings of the RMC surface scans.

"The people from (RMC) who surveyed Westlake Landfill on the 12th, have informed me that there are 'hot spots' on the landfill… Shuman Cement Company leases the space where its building stand atop one of the hot spots."

Three Sanitary landfill permits were issued during this time period. Permit 118906 was issued in January 1979 in what is now the north quarry area of the OU-2 Former Active (Bridgeton) Sanitary Landfill. Permit #118908 was issued in August 1980 in what is now the middle portion of the OU-2 Inactive Sanitary Landfill.[8] Permit #118909 was issued in 1981 that overlaps permit #118906 and extends into the neck area of OU-2 Former Active (Bridgeton) Sanitary Landfill. Planning was documented regarding attempts to regrade the waste within the existing OU-2 demolition landfill and extend demolition landfilling activities into much of Area 2 over radiologically impacted cover material.[12]

"This is in reference to our past discussions concerning proposed refilling and regrading of approximately 47 acres in the northeast portion of the West Lake Sanitary Landfill along St. Charles Rock Rd… It was proposed that only demolition waste be used to bring site up to indicated grades that would enhance surface runoff and prevent ponding and at the same time, provide a suitable surface for future use"

Known aerial photographs during this time period is May 1977 and July 1979.

General CSM from 1982 to 1990

NRC continued to provide reports on the condition of West Lake Landfill releasing the details of their investigations in reports dated 1982 and 1988. From their investigation, NRC made a number of conclusions that are relevant to the CSM. The conclusions suggest that radiological material had been effectively diluted to an estimated 170,000

tons of soil, and that the extent of contamination appears consistent with previously presumed use of the fill material as final cover or grading fill over cover. Also expressed was a concern that continued landfilling operations may obscure detectable surface radiation levels. This concern was supported by subsurface soil samples detecting elevated radiological material extending out from elevated surficial readings.

"Contamination (> 5 pCi/g Ra-226) is found to extend from the surface, in several areas, to a depth of about 20 feet below surface, in two cases. In general, the subsurface contamination appears to be a continuous single layer, ranging from two to fifteen feet thick, located between elevations of 455 feet and 480 feet and covering 16 acres total area."[5]

"Auger hole measurements show that nearly all the contamination present is located below the landfill surface, although a few locations near the northwest berm in Area 2 show surface, or near surface, deposits. These deposits range from 2 to 15 feet in thickness, and appear to form a contiguous layer covering an area of about 14 acres (68,000 sq.yd.) in Area 2 and about 2 acres (10,000 sq.yd.) in Area 1. If an average thickness of 2 yards is assumed, the estimated total volume is 150,000 cu.yd., which corresponds to roughly 170,000 tons of soil. This implies that if the source of contamination was the Latty Avenue material, the original volume of 40,000 tons has been diluted by a factor of about 4, which is not unexpected, with the continual movement and spreading of materials during fill operations."[5]

"As discussed previously, the auger hole measurements detected deposits exceeding 5 pCi/g Ra-226 within a few feet of the surface, in areas where surface external radiation levels were indistinguishable from normal background levels. These results confirm suspected difficulties in detecting buried materials with surface measurements, even when using relatively sensitive portable survey instruments."[5]

"In the first place, as the landfill conditions change, so do the surface radiological characteristics. These changes were evident in the reduction of radiation levels in Area 1 between November 1980, and May 1981. It is possible that future landfill activities will obscure all detectable surface radiation levels at the site."[5]

Known aerial photographs for this period include March 7, 1982 and April 16, 1985;

General CSM from 1990 - Present

Technical documents and statements throughout the 70s to the 90s continue to suggest a CSM where the radiological fill material was generally used for final cover or fill. For example, the following excerpt from a 1995 letter to the Department of Natural Resources states:

"This area was designated as a Superfund site because there are two areas within the site that allegedly used soil contaminated with low level radioactive materials as final top cover during the 1970s"[2]

Eventually, later reports in the 2000s began to provide different and conflicting viewpoints on how radiological material was generally distributed throughout the site. Some reports suggested that radiological material may have been used for intermediate

and daily cover, thereby spreading radiological material throughout active landfill masses. Other interpretations from the same entities appear to support the final cover/grading CSM.

"The combination of the initial irregular surface of the refuse over which the soil was placed, contemporaneous placement of other soil/quarry spoil material as daily or intermediate cover, inconsistent application of the soil cover material and compaction, and the subsequent placement and additional compaction of additional waste and soil cover material, likely resulted in the materials disposed of in Areas 1 and 2 being dispersed and intermixed at the time of initial placement within portions of the overall matrix of MSW in Areas 1 and 2."[14]

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"The overall distribution of RIM can be characterized based on the results of the various investigations and the geostatistical evaluation (SSP&A, 2017). Overall, the RIM is found to occur predominantly in relatively thin lenses and layers that are intermixed and interspersed within the overall matrix of decomposing solid waste (see Appendix B). This intermixed RIM and solid waste occurs throughout much, but not all, of Areas 1 and 2 (see Appendix B). As illustrated in Appendix B, the occurrence of RIM does not represent a continuous layer within a specific depth or elevation interval. Rather, the RIM represents thin layers of variable occurrence through much, but not all, of Areas 1 and 2. Such occurrences are consistent with use of soil material containing radionuclides as daily cover material which would have been placed primarily on inclined, irregular surfaces of the working face of the disposed refuse. Such material would have been subject to displacement from initial compaction of the material and further displacement as additional refuse and additional cover material was placed and further compacted these areas. Furthermore, subsequent decomposition, consolidation and settlement of the emplaced refuse would have resulted in further differential displacement of the cover material layers. The presence of RIM intervals reported to be thicker than the nominal 6-inches of daily cover or 12-inches of intermediate cover may reflect disposal of additional soil material at the time of placement (i.e., placement of more than the minimum required thickness or direct disposal of soil containing radionuclides), larger vertical thicknesses present on inclined (e.g., working face) surfaces, vertical redistribution of the emplaced cover materials as a result of decomposition, consolidation and settlement of the refuse over the past 40 years, erosion of cover materials prior to burial, or gamma signatures that extend above and below the actual intervals of radionuclide occurrences in the subsurface (i.e., 'shine')."[15]

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"Most of the radionuclide activity present in Areas 1 and 2 occurs within 12 feet of the 2005 land surface. The remaining activity is distributed unevenly and in regions of lower relative proportions at depths of greater than 12 feet. This pattern is driven largely by the distribution in Area 2 because Area 2 contains about four times as much activity as Area 1. Calculations indicate this distribution of activity with depth is consistent across activity concentration thresholds. The interval from 12 to 16 feet exhibits relatively little activity."[16]

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"These calculations show that the majority of the radionuclide activity present in Areas 1 and 2 occurs at shallower depths. Indeed, the graphs presented below that depict the results of these calculations demonstrate that, regardless of which threshold value is considered, the majority of the radionuclide activity present in Areas 1 and 2 occurs within the upper 12 feet below the 2005 land surface. RIM occurrences at depths greater than 12 feet are unevenly distributed and isolated and contain only a very

small percentage of the total activity. When the proportion of the total activity present within increasing depth is evaluated in regular increments (e.g., every 4 feet), it becomes evident that relatively little additional activity would be recovered going deeper than 12 feet. Supporting calculations indicate that this pattern is driven largely by the distribution in Area 2, because Area 2 contains about four times as much activity as Area 1."[17]

Given that some ambiguity has more recently been introduced regarding the use of radiological material, specifically the responsible parties' conclusion that daily and intermediate cover may have included radiological fill material, consideration will be given to active landfilling activities occurring throughout the time period.

<u>OU-1 Area 1 Conceptual Site Model:</u>

Aerial photographs appear to largely confirm the NRC's general radiological CSM during the '70s and '80s. Known complicating factors include the utilization by 1982 of the northern portion of Area 1 for vehicle traffic and the issuance of Permit #118906 in January 1979 over the southern portion of Area 1. Depending on how much extra fill had been placed over radiological fill before landfilling for permit #118906, it appears plausible that radiological material may have mixed in with landfilled material in this waste unit. Subsequent investigations suggest that the previous cover still remains largely intact.

"With two exceptions (boring 5-3, where slightly more than 9 feet of RIM was encountered, and boring 1D-7 where up to 15 ft of RIM appears to exist), the thickness of RIM in the other 135 GCPT borings and 49 Phase 1 soil borings were generally less than 3 feet and the majority were approximately one to two feet thick."[13]

"With the exception of five samples (one each in borings 1-2, 8-1, 1D-7, 1D-9, and 1D- 15), all of the occurrences of radionuclides at levels above the EPA criteria encountered during this investigation were located at elevations that were between the estimated 1971 and the 1975 topographic surfaces."[13]

Comment 1-1: OU-1 Area 1 additional investigation conclusions:

For OU1 Area 1 excavation and more accurate calculation of total activity, higher density soil sampling should be performed in areas where the 2005 topographic surface elevation is within 20 feet of the 1971 to 1975 surface elevation.

For boundary confirmation, which may affect UMTRCA extent of cover and limits of more restrictive ICs/ECs, sampling and investigation should consider the responsible parties' CSM cited in recent primary documents. It should address the possibility that after closure, Area 1 may have been later disturbed for disposal access and fill staging during operations for permits #118906 (July 1979 aerial photo) and #118909 (March 1982, April 1985 aerial photos), thereby allowing radiological material to be transferred to daily and intermediate cover fill that arrived later.

For extent of historical impacts, the investigation should incorporate soil and sediment sampling outside of the north OU-1 Area 1 fenceline adequate to address active vehicle

traffic and stormwater runoff during timeframes when material was present at or near the surface of the northern portion of OU-1 Area 1.

OU-1 Area 2 Conceptual Site Model:

It is unclear from available documents how much active landfilling occurred in Area 2 starting from the time radioactive material started arriving in July 1973. Analysis of the May 4, 1971 aerial photograph suggests waste disposal was occurring in the western portion of Area 2 and in an area along the far northern boundary. No accompanying interpretation was found for the May 4 and September 19, 1973 photo. The next interpreted photograph on May 6, 1974 shows a small waste disposal area in the far northeast corner of OU1 Area 2 with no landfilling activity throughout the rest of the area. A road leads to fill dumping/staging locations in the central and western part of Area 2.

By May 1979, OU-1 Area 2 surface appears largely dominated by fill staging areas, remaining so throughout the 1980s. Nearby active landfilling was occurring in the OU-2 Inactive Sanitary Landfill and OU-2 Demolition Landfill. Permit #218903 area #5 was available for use in OU-1 Area 2, however it is not clear from the photographs how much landfilling was occurring in the OU-1 Area 2 portion of the permit. It is estimated that by 1984, permit #218903 area #5 ceased accepting waste when the overlapping permit #218912 permit was issued in the OU-2 demolition landfill.[8]

The Shuman building can be seen for the first time in the 1979 photograph.

Recent data and statements by the responsible parties appear to support NRC's original findings in the late '70s early '80s. However, OU-1 Area 2 appears to remain active throughout the 80s with the leasing of part of the property, construction of an on-site building, and extensive use of the surface for staging additional fill. Given these complicating factors and the wide availability of RIM at or near the surface currently, the overall distribution of RIM at West Lake Landfill may have been affected.

Comment 1-2: OU-1 Area 2 Additional Investigation conclusions:

For OU-1 Area 2 excavation and more accurate calculation of total activity, higher density soil sampling should be performed in areas where the 2005 topographic surface elevation is within 20 feet of the 1971 to 1975 surface elevation.

For OU-1 Area 2 excavation and more accurate calculation of total activity, additional investigation of the northeast corner (based on 1974 photo) and the southeast corner of OU-1 Area 2 (based on active permit #218903) to determine potential use of RIM as final cover, in addition to daily and intermediate cover as described by the responsible parties.

For boundary confirmation, which may affect UMTRCA extent of cover and limits of more restrictive ICs/ECs, sampling and investigation should extend into the OU-2 Demolition and Inactive Sanitary Landfills as described in their respective CSM conclusions.

For extent of historical impacts, the investigation should incorporate soil and sediment sampling outside of OU-1 Area 2 fenceline adequate to address active vehicle traffic and stormwater runoff during timeframes when material was present at or near the surface of the northern portion of OU-1 Area 2 during active landfilling and use of the Shuman building.

<u>OU-2 Demolition Landfill Conceptual Site Model:</u>

No radiological investigation occurred in this area due to lack of initial fly-over and surface scan results. The May 1974 aerial photograph indicates active landfilling in OU-2 Demolition landfill, possibly associated with permit #218903 permitted area #1. If radiological material were being used as daily or intermediate cover, as the responsible parties have asserted, it may be possible that NRC's initial flyover by 1978 was not sensitive enough to detect any radiological signatures from prior landfilling operations in OU-2 Demolition Landfill if it were present.

Fill accumulation in or near OU-1 Area 2 appeared to continue through the 1985 Aerial Photograph which would carry those activities through the Sept. 1984 issuance of Permit #218912 and later time period.

Records show a lack of soil sampling in OU-2 Demolition landfill for any constituents, possibly due to the presumptive remedy approach for OU-2.

Comment 1-3: OU-2 Demolition Landfill Additional Investigation conclusions:

For boundary confirmation, which may affect UMTRCA extent of cover and limits of more restrictive ICs/ECs, radiological sampling and investigation should extend into the OU-2 Demolition Landfill. Higher density sampling may be needed to cover the area represented by Permit #218903 area #1 as potential final cover due to the time frame in which it was active/closed. Additional investigation should determine the potential use of fill material staged from OU-1 Area 2 as daily and intermediate cover in OU-2 Demolition Landfill from 1974 through 1985.

For extent of historical impacts, the investigation should incorporate soil and sediment sampling outside of OU-2 Demolition Landfill fenceline adequate to understand potential historical effects of stormwater management through the current NPDES outfall #9 and any other nearby historic outfall locations.

<u>OU-2 Inactive Sanitary Landfill Conceptual Site Model:</u>

Within the OU-2 Inactive Sanitary Landfill, Demolition landfilling permit #218903 area #3 in the northern part of the operable unit was carried over into state regulatory authority. Sanitary landfilling permit #118903 in the southern part of the Inactive Sanitary Landfill was also carried over, with the requirement that 2 feet of compacted fill be placed between the pre-regulated waste and the new waste.[9] If final cover was applied over pre-law waste, it is unknown if it would have been detected at the surface by the time of NRC's first aerial flyover in 1978. The OU2 Inactive Sanitary Landfill appears to have been very active based on aerial photos and based on the time frames between permit issue dates and dates when waste acceptance ceased for those permits. Active landfilling was occurring in the #218903 area #3 portion of OU-2 Inactive Landfill by the May 1974 aerial photograph that continued through the April 1985 photo. Radiological fill material may have been used for final cover between pre-regulation waste and post-regulation waste for permits #218903 and #118903. It appears plausible that radiological material could have been used as daily and intermediate cover in active landfilling areas (post-regulation #218903 and #118903; #118908) of the OU-2 Inactive Sanitary Landfill between 1974 and 1985.

Only two soil borings were found within OU-2 Inactive Sanitary Landfill that contain soil sample results. In comparing the CSM to soil borings WL-219 with sample depths of 5 feet and 10 feet below ground surface, and WL-220 with sample depths at 5 feet and 25 feet below ground surface, the sample intervals do not appear to represent CSM biased locations. Some recent draft planning documents have made statements citing the OU-1 Remedial Investigation Addendum document for substantive OU-2 soil sampling/investigation results for the Inactive Landfill, but those claims could not be substantiated. The OU-2 Record of Decision does not present soil sampling data, leading to the conclusion that, similar to the OU-2 Demolition Landfill, limited if any soil sampling occurred. This may be due to implementation of the presumptive remedy approach for OU-2.

Comment 1-4: OU-2 Inactive Sanitary Landfill Additional Investigation conclusions:

For boundary confirmation, which may affect UMTRCA extent of cover and limits of more restrictive ICs/ECs, radiological sampling and investigation should extend far into the OU-2 Inactive Sanitary Landfill. Higher density sampling may be needed to cover the area potentially represented as final cover for pre-law Permit #218903 area #3 and Permit #118903. Additional investigation should consider the potential use of fill material staged from OU-1 Area 2 as daily and intermediate cover in the OU-2 Inactive Sanitary Landfill from 1974 through 1985.

For extent of historical impacts, the investigation should incorporate soil and sediment sampling outside of OU-2 Inactive Landfill fenceline adequate to understand potential historical effects of stormwater and leachate management.

Comment 1-5: OU-2 Bridgeton Sanitary Landfill Additional Investigation conclusions:

See boundary confirmation comment for OU-1 Area 1. Consideration should also include radiological sampling and investigation based on previous north quarry sampling plans discussed between EPA and the West Lake Landfill technical community advisory group.

References:

1. Bridgeton Landfill Permit Consolidation Engineering Report by Herst and Associates Inc. 10/8/2008
2. Spencer Fane Britt & Brown Attorneys and Counselors at Law, letter to Mr. James Bell at Missouri Department of Natural Resources, April 19, 1995.
3. Missouri Department of Natural Resources internal Memorandum from Burt McCullough to Robert J. Schrieber, Nov. 19, 1980
4. United States Nuclear Regulatory Commission Investigation Report No. 76-01, January 4, 1977
5. 1982 NRC Radiological Survey of the West Lake Landfill NUREG/CR-2722 Report
6. 1988 Radioactive Material in the West Lake Landfill Summary Report NUREG-1308
7. 1989 UMC report
8. July 14, 2011 Aquaterra waste limit boundary investigation and drawings
9. August 27, 1974 municipal solid waste permit approval for #118903
10. October 10, 1974 demolition waste approval for #218903
11. Aerial Photographs and interpreted overlays Contract #68-03-3245
12. 1982 letter from Reitz & Jens to DNR regarding additional landfilling plans for Area 2
13. OU-1 Area 1 Comprehensive Phase 1 Report (2016)
14. Remedial Investigation Addendum (2018)
15. Final Feasibility Study (2018)
16. Bridgeton Landfill LLC comments Regarding the Proposed Record of Decision Amendment – West Lake Landfill Superfund Site, Operable Unit One (February 2018)
17. EMSI Technical Review of EPA's Remedial Criteria April 23, 2018
18. Environmental Cleanup Best Management Practices: Effective Use of the Project Life Cycle Conceptual Site Model, Quick Reference fact sheet EPA 542-F-11-011, July 2011

2. Many of the proposed borings in the DIWP rely on a geostatistical model that is not understood, reproducible, or approved. Because the DIWP does not effectively address the comments provided on the PEP and has not further developed the model for use in the RD, we are unable to confirm if the proposed boring locations or proposed monitoring and sampling will accomplish the objectives of the investigation. There is little doubt that collection and analysis of the proposed samples and monitoring information will help any geostatistical model. Therefore, we see the value in mobilizing a soon as possible to allow time for additional field investigations, as needed, to strengthen the model once it is understood and the modeling methodology is approved. However, we see greater value at this time in sampling less densely sampled areas now rather than localized high density sampling that relies on information provided by the current draft geostatistical model.

Specific Comments, Design Investigation Work Plan and Appendices:

3. Section 3.0 Additional Data Needs, page 3-1: The current items 1 and 2 in the DIWP only detail investigation along the current assumed boundaries between operable units.

   Comment: Add an additional investigation item to the list consistent with statement of work item 3.6(a)(1)(iii) to include boundary confirmation of OU1/OU2.

4. Section 3.0 Additional Data Needs, page 3-1: *"This DIWP includes data collection for improvement of the geostatistical model as used to estimate locations with a 50% probability of containing RIM greater than 52.9 pCi/g."*

   Comment: Not enough is known about the model to determine if the stated decision criteria is appropriate therefore we are not able to provide an opinion on decisions based on this criterion.

5. Section 3.0, Page 3-1: *"GSMO #1 (Figure 5A): Increase sampling density in specific gamma count ranges to improve correlations between radium, thorium, and gamma using core data;"*

   and

   Appendix E, Sections 1.2.1 and 1.2.3, page E-4 and Figure E-1: *"Existing hard data has high data density at concentrations below 7.9 pCi/g, but between 7.9 and 10,000 pCi/g there is insufficient data density because laboratory analytical samples were typically sampled from the highest core gamma scan intervals in previous investigations. These ranges will be targeted for sample collection in the field using related gamma counts to improve quantified relationships of radium and thorium."*

   and

"Specific areas targeted for increased data collection include thorium specific data collection in the gamma count target range of 30,000 to 300,000 counts per minute (cpm), and radium-specific data collection in the gamma count target range of 40,000 to 500,000 cpm (Figure E-1)."

Comment 5-1: Describe how the proposed gamma count target ranges for both Thorium and Radium were determined. Using Figure E-1, it appears the lower end of the gamma count target range corresponding to 7.9 pCi/g is much less than the proposed CPM of 40,000.

Comment 5-2: Please provide a link between GSMO #1 and the proposed boring and sampling horizon locations. How are the proposed borings locations anticipated to meet the gamma count target range? Were the borings located using a map showing predicted CPM for Area 1 and Area 2? Please provide a reviewable, reproducible process.

6. Section 3.0, page 3-1: The geostatistical model is attempting to predict the non-exceedance of Thorium. The PEP and the DIWP do not provide demonstration that gamma data can be used to predict non-exceedance of Thorium. Although GSMO #1 is geared towards improving correlations between Radium, Thorium, and gamma, there appears to be no connection to non-exceedance of Thorium.

   Comment: Please analyze the relationships of Radium, Thorium, and gamma to determine what field data would best strengthen the model's ability to predict non-exceedance of Thorium. The closest the document comes to addressing this issue is defining a CPM target range of 30,000 to 300,000 CPM but does not provide any reviewable information related to how this range represents gamma levels near and below the threshold value for Thorium.

7. Section 3.0, Page 3-2: *"Increase laboratory analytical sampling density in gamma count ranges from 40,000 to 500,000 counts per minute (cpm), as measured during core scanning;"*

   Comment: This gamma count target ranges is inconsistent with Appendix E. Please see other comments related to demonstrating an appropriate target range.

8. Section 3.1 RIM Investigation: The scope of RIM delineation in this section is too narrow to meet goals described in the statement of work.

   Comment: Add a subsection for OU1/OU2 boundary confirmation consistent with statement of work item 3.6(a)(1)(iii).

9. Section 3.1.4.2 Background Concentrations, page 3-8: *"Analytical results from these surface samples will be evaluated to determine a range of used to evaluate these reference areas for comparison to statistically valid background concentrations."*

   Comment: Review and revise the statement to make sense.

10. Table 2:

    Comment: Add Design Investigation Objective consistent with statement of work item 3.6(a)(1)(iii) for boundary confirmation of OU1/OU2.

11. Perimeter boring figures: The proposed OU1/OU2 boundary confirmation borings are inadequate. The current perimeter boundaries are estimated based on limits placed on the modeling, and sampling performed in limited areas. Therefore the OU1/OU2 boundary sampling should not be limited to current perimeter locations.

    Comment 11-1: Include RIM boring locations in OU2 sufficient to represent the depth and aerial extent of final cover over permits #218903 and #118903.

    Comment 11-2: Include RIM boring locations in OU2 sufficient to represent the depth and aerial extent of daily/intermediate cover over permits #218903, 218912, 118903, 118908, 118906, and 118909 through the period of 1973 to at least 1985.

12. Appendix E, Sections 1.2.1, 1.2.2, and 1.2.3:

    Comment: Please provide an analysis of the different correlations mentioned and show how collecting targeted field data might improve the correlations. For example, please provide an analysis of the Thorium to Radium correlation and identify the areas of the correlation that are week or less data dense. Then describe what concentration of both Thorium and Radium are being targeted. Then describe how locating borings and collecting samples from certain horizons are meant to improve the datasets. If correlation from Radium to normalized gamma response is needed to determine the best locations within the current geostatistical model, then please provide a demonstration of this correlation and how normalized gamma response ranges are targeted and then converted to proposed boring and sampling horizon locations.

13. Appendix F, Design Investigation Groundwater Monitoring, Site Hydrology page 2: *"The radiologically impacted material (RIM) within OU-1 Areas 1 and 2 is located within unconsolidated materials (waste, fill, and alluvium), and the Alluvial Zone is therefore the hydrogeologic zone with the greatest potential to be impacted by the RA. Given that the objectives of the OU-1 groundwater monitoring program are focused on the evaluation of the remedy's performance, the program will accordingly rely primarily on wells that monitor the Alluvial Zone. However, the program will also incorporate wells that monitor the St. Louis / Upper Salem Zone, to provide monitoring of the nearest*

underlying groundwater unit." The purpose of the OU3 investigation is to determine impacts to groundwater.

Comment: Delete this paragraph and any other presumptive conclusionary statements.

Comments on the Design Investigation QAPP

14. General comment: The QAPP is not sufficiently developed for review and acceptance of the plan. There is not enough information to identify all the design investigations to be performed, determine questions that will be answered, and determine how the two concepts will address known data gaps and data needs. Select examples are provided below, along with an attempt to provide specific comments for what information is available.

    Comment: Submit a complete and detailed design investigation work plan.

15. General comment: Information regarding some of these comments is included in the field sampling plan. In general, information regarding specific procedures for sample collection and operation, maintenance, and documentation for field equipment may be included in the FSP with references to FSP sections made in the QAPP. However, information pertinent to the quality of data collected during the various activities throughout all phases of the project (such as SOPs for field measurements, sample collection, GPS, and required consumables) should be included in the QAPP as well.

    Comment: Include information in the QAPP that is pertinent to the quality of data collected during the various activities throughout all phases of the project.

16. General comment: Define 2005 Ground Surface, and add B2005GS in the list of acronyms in all documents.

17. Table 11-1, page 14: The principle study questions do not contain questions related to RAOs such as gas and leachate monitoring, Statement of work goals such as boundary confirmation of OU1/OU2, and implementation questions such as characterization of potential waste to be encountered during excavation, or settlement potential of both undisturbed and disturbed areas to be covered.

    Comment: See general comment 14.

18. Page 19: *"While considered qualitative due to reasons identified, the geostatistical processes use the gamma data by inclusion in the cumulative distribution function as part of the indictor assignment for indicator kriging at multiple thresholds. In doing so, the gamma measurements are essentially weighted such that they can be used in support of identification of RIM, but with less influence than the laboratory measurements."* As mentioned in these statements, qualitative data is being used to quantify specific concentrations of radionuclides. This requires quantitative DQOs.

Comment: Include detailed quantitative DQO for the conversion of screening data to concentration values.

19. Page 21: Sediment Section referencing page 20 “Outputs of this Step” - This section does not appear to provide a description of the spatial and temporal boundaries of the problem.

    Comment: Provide information consistent with development of a DQO. See general comment 14.

20. Page 22: We are unable to determine agreement with alternative action criteria due to lack of understanding of the underlying model used to indicate an alternative action.

    Comment: Provide sufficient information on the model and/or use alternate criteria for alternative actions. See general comment 14.

21. Performance criteria is unreviewable.

    Comment: Provide performance criteria sufficient for review. See general comment 14.

22. Worksheet #12, pages 30-38: All data pertain to laboratory parameters for evaluating groundwater and waste. There should be discussion in Measurement Performance Criteria for “GPS location” and “depth measurement” of samples in this section. (Geolocation and “historical or measured depth of samples” is likewise not discussed in Worksheet #13.)

    Comment: See general comment 14.

23. Referencing comment 3, page 39, Worksheet 13, Secondary Data Uses and Limitations: *“OU-1 Subsurface Soil Radiological Field Screening Data”* mentions *“1982 sampling depth inaccuracies”* as a factor affecting reliability of data, for instance, whereas no discussion of accuracy of depth or geolocation of samples appears in this QAPP for future samples that will be gathered under it.

    Comment: See general comment 14.

24. Page 40, Worksheet #13 Table continued, *“Data uses relative to current project”* has a hyphen in this column for most items. There should be some descriptive entries in the table instead of hyphens.

    Comment: See general comment 14.

25. Pages 61-85 *"Area 1 and Area 2 Sampling locations and methods"* discussions before tables do not make reference to geolocation of samples or methods to determine depths of samples or measurements.

    Comment: See general comment 14.

26. Page 93 Worksheet #22 and page 108 Worksheet #25: Geolocation equipment and depth measurement equipment (as applicable) calibration, maintenance, testing, and inspection is not present.

    Comment: See general comment 14.

27. In general, neither the location of specific individuals responsible for maintaining the official copy of the QAPP, nor a statement of how all individuals specified will receive the most current copy of the QAPP from the specified individual when modified was found (EPA QA/G-5, Example Checklist, C-6, A-9 item 5).

    Comment: Provide adequate statements related to maintaining and sharing the most current copies of documents.

28. In general, lab SOPs were provided but no field collection sampling SOPs were found including: sample geolocation, sample depth measurement, physical sampling methods such as auger or drill. SOPs should be detailed for survey and field collection methods, geolocation of samples/surveying (EPA QA/G-5, Example Checklist, C-7 to C-9, B2).

    Comment: See general comment 15.

29. Sampling SOPs should specifically detail whether and how sampling equipment should be decontaminated and how by-products will be disposed of (EPA QA/G-5, Example Checklist, C-9, B2 Item 8).

    Comment: See general comment 15.

30. Discussion of Inspection/Acceptance for Field and Lab Supplies and Consumables was not found, nor was identification of individual(s) responsible for this work identified. ("Identify critical supplies and consumables for field and laboratory, noting supply source, acceptance criteria, and procedures for tracking, storing, and retrieving these materials…and identifies the individuals responsible for this." EPA QA/G-5, Example Checklist, C-12, D8).

    Comment: See general comment 15.

Comments on the Field Sampling Plan

31. Section 2.4.3.1 Laboratory Analytical Sample Collection Strategy, page 2-21: *"These target depths are derived from the data needs outlined in the Geostatistical Modeling Objectives (GSMOs) and Design Investigation Objectives (DIOs) as described in the Quality Assurance Project Plan (QAPP)."* The QAPP does not have this referenced discussion.

    Comment: Include details in the referenced discussion.

West Lake OU-1 RD SOW 5-7_d Field Sampling Plan 2020-3-30 MDNR Draft Comments April 23, 2020				
Main Section	**Subsections**	**Page**	**Location on Page and/or Section**	**Comment**
List of Acronyms		vi	General	Add the following acronyms to the list or include definition on specific figure or table the acronym is being used in: BZ, RU, AC, NWB, SB, PB,
2.1 Mobilization	2.1 Mobilization	2-1	2nd Paragraph of section	Radiation detection equipment should be added to the list of field instrumentation to be used during sampling.
			3rd Paragraph of section	Reference should be made to the Attachment Section where the standard forms to be used are located.
	2.1.5 Event Notification	2-6	Last 2 sentences of 1st paragraph of section	The appropriate regulatory notification and application of ARARs should be followed if a UST system is encountered.
2.2 Design Investigation Field Activities/Soil Boring Installation	2.2 Soil Boring Installation	2-6	2nd Paragraph, 2nd sentence	Daily briefings should be held with field personnel regarding potential hazards.
		2-7	Last sentence/last paragraph	Include reference to 10 CSR 23-4.080 at end of sentence.
	2.2.1 Drilling Methods	2-7	Last sentence of last paragraph on page	Include reference to 10 CSR 23-4.080 (Plugging of Monitoring Wells) to the end of the last sentence of the last paragraph on page.
		2-8	Last sentence of first paragraph on page	Include reference to 10 CSR 23-4.080 (Plugging of Monitoring Wells) to the end of the last sentence of the first paragraph on page.

	2.2.1.2 Sonic Drilling		2-8 and 2-9	2nd, 5th and 6th paragraphs in section	Any water used in the generation of drilling fluids or during drilling operations should be potable.
	2.2.2 Borehole Decommissioning	2.2.2 Borehole Decommissioning	2-9	1st paragraph of Section 2.2.2	Abandonment of Monitoring wells and borings should be conducted per 10 CSR 23-4.080 regardless of the specific data collection needs of the boring in question. Temporary monitoring wells (including soil borings) 10' deep or greater must be plugged by removing any temporary pipe and filling the well or boring from total depth to 2' from the ground surface with approved grout as defined in 10 CSR 23-4.060 and the remainder of the well or boring filled with compacted uncontaminated native material or grout. Include reference to 10 CSR 23-4.080 at end of the last sentence of the 1st paragraph, Section 2.2.2.
		2.2.2.1 Borings for Soil Classification and Sampling	2-9	Last sentence in only paragraph of subsection 2.2.2.1	Revise last sentence as follows: Grout will consist of a mixture of Portland cement (Type 1) and bentonite in compliance with approved grout defined 10 CSR 23-4.060, which will be tremied through the drill string as it is being removed and completed to attain compliance with ARAR 10 CSR 23-4.080.
		2.2.2.2 Boring for Downhole Gamma Logging	2-9 and 2-10	General	More details are needed regarding installation and period of time temporary casing is needed in borings used for downhole gamma logging and abandonment procedures for the borings when data collection is complete. Installation and abandonment of these type of borings has been a concern in past investigation efforts at the site (2014 Bridgeton Landfill/OU-1 Coring Work Plan and addendums). If a specific procedure has been approved recently in other documentation, please include that reference.
			2-9	Last complete sentence on page	Replace the term “sheeted” with typically used industry term “cased”. The sentence should also include a reference 10 CSR-4.060 which lists the approved casing materials.
			2-10	Last sentence of subsection 2.2.2.2 continued from page 2-9	Revise the next to last sentence as follows: Grout will consist of a mixture of Portland cement (Type 1) and bentonite in compliance with approved grout defined 10 CSR 23-4.060, which will be tremied through the casing as it is removed and completed consistent with ARAR 10 CSR 23-4.080.
			2-10	Only sentence in 2nd (last)	Revise sentence as follows: Proposed borings that require installation of monitoring well and piezometer will be constructed in accordance

				Paragraph of Section	with Section 2.5.1 and 10 CSR 23-4.060 and decommissioned as per Section 2.5.3 and 10 CSR 23-4.080.
2.3 Subsurface Measurements	2.3.1.3 Drilling Procedure		2-10	Item 3	If drilling fluids are necessary they should be potable. Suggest limit use of fluids as doing so may increase the potential for spreading contamination. Use of any fluids should be approved ahead of time by project management and appropriate regulatory staff.
	2.3.1.4 Standard Penetration Testing Procedure		2-10	Item 6	First word in sentence misspelled: "Reference"
	2.3.2 Downhole Gamma Logging	2.3.2.2 Equipment and Supplies	2-11	First Bullet Item	Typographical error and incomplete equipment manufacturer: Portable ratemeter-scaler: Ludlum Measurements, Inc. (LMI) Model 2221 or equivalent.
		2.3.2.4 Downhole logging Procedure	2-11	Second sentence in Item 1	Incomplete equipment manufacturer name. Can use acronym defined in previous section: …involving a LMI Model 44-2…
			2-11	Last sentence in Item 1	Description of borehole details is too vague and borehole/piping diameters seem incorrect. Additional details are needed on completion (including PVC installation), length of usage and abandonment of borings used for downhole gamma logging. Installation and abandonment of these type of borings has been a concern in past investigation efforts at the site (2014 Bridgeton Landfill/OU-1 Coring Work Plan and addendums). If a specific procedure has been approved recently in other documentation, please provide that reference. Installation of this type of boring for downhole gamma logging may require preapproval and/or a variance from MGS.
2.4 Soil and Sediment Sampling	2.4.1 Soil Description	2.4.1.1 Equipment and Supplies	2-13	List	Add Sample Labels to this list.
		2.4.1.5 Field Observations of Contamination, Putrescence or Site-Specific Characteristics	2-14	Sentence under Screening	Sentence should be revised as follows: Samples will be screened with radiation detectors for alpha, beta and gamma radiation and with a photoionization detector (PID) for volatile organic compounds (VOCs). A reference should also be included to the section on Field Screening/Scanning of Site Samples (2.4.1.6 or correct section number that is determined).

		2.4.1.6 Asbestos Inspection	2-14	General	These 2 sections have the same section number. Suggest review and correct as necessary.
		2.4.1.6 Field Screening/Scanning of Site Samples			
		2.4.1.6 Field Screening/Scanning of Site Samples	2-14	General and Specific: Last sentence	This section should include more detail regarding the types of field screening done and discuss the equipment used for each type: PID for VOCs and the specific radiation detection equipment used to detect alpha, beta, and gamma radiation. A reference should also be included to section 2.4.3 (Subsurface Soil Sampling) in last sentence of paragraph regarding the use of field screening to select intervals for sample collection.
		2.4.1.7 Descriptions of Landfill Waste	2-14	General	This section should include an introduction paragraph that states: Site media consisting of landfill waste will be classified and described using the following scales for moisture content and decomposition.
	2.4.3 Subsurface Soil Sampling	2.4.3.1 Laboratory Analytical Sample Collection Strategy	2-21	Bullet 4: GSMO-5	TH-92 should be included in addition to proposed borings TH-125 and TH-127 to fulfill data needs associated with perimeter borings in Area 2. TH-125 and TH-127 fulfill this need along the eastern perimeter of Area 2, specifically delineating RIM to 25 feet B2005GS. Additional delineation of RIM is needed along the southern perimeter of Area 2 and adding TH-92 with the sample collection technique proposed for TH-125 and TH-127 will fulfill this need.
	2.4.4.4-2.4.4.6 Water-Based Sediment Soil Sampling Method	Hand Coring	2-25	Item 13	Replace term “fields” with “field parameters”
		Hand Auger through Casing	2-26	Item 19	
		Ponar Dredge	2-27	Item15	
	2.4.5 Laboratory Analytical Constituents	2.4.5.3 Sediment Sample Analytical Parameters	2-28	List	Th-228 is included on the list of analytical parameters for groundwater samples but not for sediment samples. Suggest review and revise as appropriate.
2.5 Monitoring	2.5.1 Monitoring Well Installation		2-30 & 2-31	Information in narrative vs schematic	The monitoring well schematic on page 2-31 includes 2 types of filter pack (primary and secondary) but narrative on 2-30 does not. Suggest review and revise to be consistent.

					Schematic on 2-31 also includes an apparent artifact (bracket on right side of well diagram) possibly from an earlier use of the figure. Suggest review and revise as appropriate.
	2.5.3 Monitoring Well Decommissioning	2.5.3.2 Field Procedure	2-33	Item 5	Cuttings extracted during creation of a temporary boring or temporary piezometer may not be used to backfill the boring for the following reasons: 1. Pursuant to ARAR 10 CSR 23-4.080: Temporary monitoring wells 10' or greater in depth must be plugged by removing any casing and filling the well from TD surface with approved grout (10 CSR 23-4.060). 2. Cuttings should not be used to backfill borings or wells regardless of depth due to the various contaminants present at the landfill that may not be detected visually or with the available field screening equipment. 3. Backfilling the borings with cuttings would also create a potential conduit for vertical migration of contamination.
2.6 Water Sampling and Hydrologic Measurements	2.6.1 Groundwater Sampling	2.6.1.2 Groundwater Sampling Method	2-34	First paragraph in section	A reference to Section 2.9 (Collection and Disposal of IDW) should be included to address the collection and disposal of purge water accumulated during sampling. A reference to **Attachment 9**, the form used to record field data during ground water sampling should be included.
			2-34 & 2-35	Item 3 on each page	The frequency that parameters are collected for both types of wells (< 25’ deep and >25 feet deep) should be included. Parameters are typically measured every 3 minutes until stabilization criteria for water quality parameters have been met.
	2.6.2 Surface Water Sampling	2.6.2 Surface Water Sampling	2-36	First paragraph in section	A reference to **Attachment 11**, the form used to record field data during surface water sampling should be included.
		2.6.2.2 Surface Water Sampling Method	2-36	Item 4	Water quality parameter readings taken from the water left in the cup or bucket after sample collection would not be a true representation of conditions present in the sampled water body. Water quality parameter readings should be collected from the water body being sampled immediately before sample collection.

	2.6.4 Laboratory Analytical Parameters	2.6.4.1 Groundwater Analytical Constituents	2-37	List	Th-228 was included on the groundwater list of analytical parameters, but not on the list of sediment analytical parameters. Suggest review and revise as appropriate. Specific field parameters that are being collected should be included on this list.
		2.6.4.2 Leachate Analytical Constituents	2-37	List	Some or all of the Thorium isotopes (Th-228, Th-230, and Th-232) are included on the sediment and groundwater analytical parameter lists. Suggest review and revise as appropriate.
2.8 Decontamination	2.8.1 Radiological Surveys	2.8.1.1 Baseline Entry Survey - Equipment	2-40	First sentence of paragraph in subsection.	This paragraph refers to entry only into Area 1, which may be an omission or typographical error. The information in this section pertains to both Areas 1 and 2 of OU-1. Suggest review and revise as appropriate.
		2.8.1.2 Permitted Area Exit Survey - Personnel	2-40	Last sentence on page	This paragraph refers to "ambient background level". Recommend defining this level or reference to the procedure for its determination.
2.9 Management of Investigatory-Derived Waste			2-42	General	References to this section are made in previous sections of the document. Specific details for IDW management should be stated here. References to historical documents where this information can be found is insufficient.
3.0 Sample Management	3.1 Field Sample Records	3.1.2 Location ID	3-2	4th Line on page	The use of "S" for "bedrock" may lead to confusion with the use of "S" for "shallow". Suggest using "B" for "bedrock".
	3.2 Sample Handling	3.2.3.2 Shipping Preparation Procedure	3-4	Item 7	The signed COC should be secured inside a sealed plastic bag inside the cooler to prevent moisture damage during transport.
Tables			General	All	Figures Section should be inserted before the Tables Section to improve understanding of information.
Figures			Figures 1 & 2: Proposed Boring Location and IDs for Areas 1 & 2		Need to reduce size of symbols and/or text so that labeling of locations is clearer.
			Figure 6: Drainage Area Proposed Sediment Sample Locations		Map should include labels marking Northern Surface Water Body and Earth City Flood Channel.

Attachments	Attachment 3: Core Log	This core log should be modified to be more specific to the condition encountered at the landfill and include a column for field screening data (PID and Radiation). Specific names of Drilling Contractor and Driller (artifacts from previous usage of this form) should be removed.
	Attachment 11: Surface Water/Seep Sampling Record	Units should be included for each field test parameter.
	Attachment 12: Sediment Sampling Record	Units should be included for each field test parameter.
	Attachment 13: Surface Soil Sampling Record	The field test parameters listed on this form are not appropriate for this type of sample collection. Suggest review form and revise as necessary.